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*with the author*  
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ON  
INJURIES OF THE SPINE.



A PROBATIONARY ESSAY  
ON  
INJURIES OF THE SPINE;  
SUBMITTED,  
BY AUTHORITY OF THE PRESIDENT AND HIS COUNCIL,  
TO THE EXAMINATION OF  
**The Royal College of Surgeons of Edinburgh,**  
WHEN CANDIDATE  
FOR ADMISSION INTO THEIR BODY,  
IN CONFORMITY TO THEIR REGULATIONS RESPECTING THE ADMISSION  
OF ORDINARY FELLOWS,  
BY  
THOMAS BAZETT TYTLER, M.D., EDIN.

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MDCCCL.



TO

SIR CHARLES BELL, K.H.

THIS ESSAY

IS DEDICATED,

WITH FEELINGS OF THE DEEPEST GRATITUDE AND RESPECT,

BY HIS PUPIL,

THE AUTHOR.





## PROBATIONARY ESSAY

ON

# INJURIES OF THE SPINE.

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THE class of injuries which form the subject of the present essay, from the importance of the parts implicated, are of the highest interest to the surgeon ; while from their frequent occurrence, especially among the casualties admitted into our great hospitals, they stand prominent among the severer cases which claim his attention, and may benefit by the skilful application of his professional knowledge.

My object will be to give, as far as lies in my power, a practical view of the various injuries to which the spinal column and its contents are liable ; with such views of treatment as seem to me best adapted for each case, and to add such reports of cases as I have been enabled to obtain, either from personal observation or from other authorities.

The injuries affecting the spine may be classed under the heads of sprain, subluxation, disloca-

tion, fracture, and concussion of the cord, independent of injury to its bony covering.

Sprain of the spine is, I believe, a case of much more frequent occurrence than has been generally supposed ; but as its immediate effects are often comparatively slight, and a long period usually elapses before the full development of the symptoms depending on it, the surgeon is apt to lose sight of, or entirely overlook the real origin of a case apparently mysterious, though really one in which effects may be fairly traced to a competent cause.

The term sprain may be applied to that condition of an articulation, in which, without any permanent displacement of the bones, there has been a violent straining of the ligaments, and disturbance of the apposition of the articulating surfaces, such injury giving rise to symptoms, more or less severe, in proportion to the violence done to the parts. Sprain of the spine may be caused either by external violence, as when a heavy weight falls on the shoulders, or when the patient is crushed under a falling mass of earth, &c. ; or it may arise from an inordinate action of the muscles, as when a person strives to carry a load beyond his strength, or makes a sudden and violent effort to recover his balance in falling. The points at which the injury is most liable to take place, are

those where the more flexible portions of the spine, viz. the cervical and lumbar, join the less moveable dorsal region. The immediate symptoms are, as in sprains of other joints, pain and stiffness, but the degree of swelling is usually much less, or, at any rate, less perceptible than that attending sprains of the more exposed joints. Under proper treatment, the symptoms usually disappear at no distant period; but when a severe case of sprain is neglected, there is apt to arise an inflammation of the spinal cord inducing paralysis more or less complete of the parts below the seat of the injury. In severe cases this unfortunate termination may arrive without there having been any remission of the original symptoms; and here the causes of the after train of symptoms are sufficiently plain. A much more difficult case arises, when an injury, so trivial originally as hardly to cause either alarm or inconvenience, is followed, after a period of considerable length, by the slow but steady incursion of paralysis, making its approach so gradually, and accompanied by so little acute suffering, that neither the patient nor his medical attendant are aware of the danger until the disease is beyond the reach of remedies. The affection alluded to resembles the slow form of idiopathic paralysis, and appears to originate in a low inflammation of the investing membranes

of the cord, which, unless checked by active treatment, gains ground, however slowly, until, by involving the roots of the spinal nerves, it causes complete paralysis of the parts supplied by them. We are thus presented with the very singular phenomenon of a patient lying in a state of absolute paralysis of the extremities while the countenance continues active, and the respiration for a long while unimpaired; at the same time the visceral functions remain for a while tolerably normal. Shortly, however, the viscera begin to suffer sympathetically; the bladder and bowels become torpid; frequently there is sloughing of the parts subject to pressure; and the patient sinks exhausted.

At the same time that both sensation of external impressions and motion are entirely gone, the patient complains of severe gnawing pains in the extremities, owing to the inflammation of the roots of their nerves. A patient in this condition expressed the sensation by saying, "My arms are dead, and yet they cannot be dead, for I have constant pain in them."

The treatment of sprain requires to be active; local bleeding by cupping or leeches, with strict confinement, low diet, and aperient medicines, are indicated by the apprehension of inflammation arising in the cord; and where these means are

judiciously employed at an early period, most cases will be productive of little more than temporary inconvenience. Even in cases where serious symptoms have set in, we may hope for an improvement from the use of counter irritation, and strict confinement to bed. In the insidious cases above alluded to, we unhappily seldom see the patient till the mischief is too far established to be driven back by treatment. The very slowness of the approach of the inflammation apparently rendering its hold more sure, and its opposition to remedies more obstinate. I am not aware whether the cautery has been applied in such cases, but I am inclined to believe that it might be advantageously employed in cases where the paralysis was induced shortly after the accident. Even in the more gradual cases of paralysis after injury, the use of the cautery appears to be countenanced by the benefit obtained by its use in several idiopathic cases in which it has been resorted to.\*

Accidents similar to those causing sprain may, when accompanied by a still greater degree of violence, cause subluxation of the spine. In this case, the articulating surfaces, although not entirely separated, yet appear to be forced into a position of unnatural relation to each other, and

\* For cases of Sprain, see Appendix.

remain, as it were, locked in their newly assumed position. The ligaments are either torn or so far stretched as to admit of the processes of the vertebræ being entangled with each other, while the alteration in the position of the bodies is rather a lateral twisting than an absolute separation, and, in consequence, the spinal canal being little, if at all, encroached upon, the cord may escape immediate injury.

The most usual cause of subluxation is the bending of the back under a heavy weight suddenly imposed on the shoulders, or, as has sometimes happened, by the attempt to drive a vehicle under a low archway, the upper part of the column is caught by the arch, while the lower is held by the seat, and the force thus falls on the intermediate portions of the spine. The injury usually takes place at the junction of the lumbar and dorsal regions, where the parts enjoy a large share of mobility.

The patient is found bent forward from the loins, unable to raise the trunk, and complaining of local pain and stiffness; there may be partial paralysis of the lower extremities, but this is by no means constant, nor usually of long duration when originally existing.

The termination of subluxation is either by the excitement of inflammation involving the cord, and leading to a fatal result more or less rapid;



or, when favourable, is, by the parts, brought into false opposition, becoming so far adapted to each other by partial absorption as to form new articulations,—in such cases the spine is gradually restored to a great share of mobility, and the erect posture eventually regained. In other cases anchylosis of the vertebræ takes place, and there remains a permanent stiffness of the loins, sufficiently distressing, but at the same time much less so than the bent position of the column immediately following the accident, which interferes materially with respiration and the other movements of the trunk.

The great difficulty in the diagnosis of a case of subluxation is its liability to be confounded with fracture; the altered position of the processes simulates very closely that of displaced portions of the arches of the vertebræ, while the depth of the muscular coverings makes it impossible to ascertain the exact nature of the case without recourse to a degree of manipulation not to be attempted in a case where it may be productive of such instant and severe bad effects. In the uncertainty which must always exist in such cases, the greatest caution must be observed in moving the patient in any way; and all that can be done, is by the strictest repose and active local, and, in some cases, general depletion, to endeavour to

ward off the attacks of inflammation which are always to be expected. Should we succeed in bringing the patient safely through the first stage, and find that paralysis either does not appear, or, if present, gradually gives way, we may give the patient hopes of eventually regaining the erect posture in a great measure, if not entirely. It is difficult to state the period during which the patient must be strictly confined to bed; but bearing in mind that subluxation, like sprain, may be followed by that low degree of inflammation which has already been described as ending in fatal paralysis, we must, in all cases, lead our patient to distrust his powers of motion, and be carefully on the watch to meet any inflammatory symptoms which may show themselves.

It is perhaps superfluous to reprobate the old practice of attempting reduction of displaced vertebræ, in the present more advanced degree of practical knowledge which we possess; but we now and then still hear of marvellous cases of reduction, which would show, that there are still some persons hardy enough to make the attempt, and we hear little of those cases in which a fatal event has occurred after such manipulation.

Total dislocation of the spine is of comparatively rare occurrence in the lower regions of the column; nor is this to be wondered at, when we



consider the great strength and complexity of articulation, which they possess. We shall find that forces capable of dislocating the vertebræ of the dorsal and lumbar regions, are much more usually productive of fracture, than of simple dislocation. In the cervical region, the chances of dislocation are increased, by the comparative weakness of the articulations; and the most usual of all is the separation of the atlas and dentata. This accident is accompanied by rupture of the transverse ligament; and the head, thus losing its support, falls forward, and crushes the cord between the posterior edge of the ring of the atlas and the odontoid process of the dentata: the pressure on the cord taking place at a point superior to the origins of the nerves of respiration, immediate death is the result, just as when an animal is killed by the operation of pithing.

Dislocation of the neck may arise, either from a fall in which the patient has pitched upon his head, or by a sudden jerking forward of the head itself, when the body is suddenly arrested in motion. The former case is familiar to all; but the latter, though rarer, is recorded in several instances, one of which I quote from Sir Charles Bell's *Surgical Observations*:—"A man driving a wheelbarrow, was suddenly arrested by the wheel striking the curbstone; he made a violent effort

to overcome the obstacle, and the barrow running onward, he fell suddenly forward ; when taken up, he was found to be quite dead, and on dissection the spinal cord was\*found to be crushed upon the odontoid process in the way formerly described." In this case there was no appearance of previously existing disease ; but in cases where the bones and ligaments have been already subject to diseased action, the chances of dislocation are of course so much the greater, from accidents liable to produce it.

Sir George Ballingall mentions\* two cases of complete dislocation of the spine ; one of the fifth and sixth vertebra, where, though no mechanical injury of the cord could be detected, the patient died of suffocation in four days, from the impossibility of expectoration. The other was a case of dislocation in the lumbar region, but no further account is given, than that the patient was not sensible of the pain of a fracture of the leg which occurred at the same time. In the last case, it seems that the cord was injured by the displacement of the bones ; while in the former, the inflammation excited by the injury seems to have spread rapidly to the nerves of respiration, destroying the healthy influence which they exert to

\* Outlines of Military Surgery, p. 308.

relieve the respiration, when stimulated by the presence of mucus in the bronchial tubes and trachea.

A case of dislocation of the last dorsal and first lumbar vertebra is related by Sir Charles Bell in his Lectures on the Spine and Thigh-bone ; but in this case, there was also a slight fracture of the lumbar vertebra ; the patient, a child, lived for thirteen months after the accident, and dying of croup, was found on examination to have the spinal cord completely interrupted by the displacement of the bones. In this case, a new ligamentous union seemed to have taken place, attaching the bones to each other in their new position.

The question of treatment, in cases of dislocation below that point at which the accident is at the instant fatal, is so intimately connected with that of fracture, that it may well be considered while treating of the latter accident. .

In proceeding to the consideration of fractures of the spine, it will be found of advantage to bear in mind the analogies which exist between the brain and spinal cord. Thus, as we have concussion and compression of the brain, sometimes together, sometimes separate, so may we have them in the cord ; and, as the inflammation of the membranes affects the brain, so does the cord suffer from inflammation set up in its coverings. A per-

son falling from a height, and striking upon the sacrum, or on a more extended surface of the back, may, without injury to the head, suffer a general concussion of the spine. In many cases, indeed, of concussion, where, from the brain being affected, the whole frame is paralysed, I have little doubt of the spinal cord having its own share of the injury, though in such cases there must always be extreme difficulty in distinguishing, in the early stages of the case, between the effects attributable to the two causes. When, however, we meet with a case in which the extremities are affected, without any impression made on the sensorium; or when, both sense and motion having suffered in the general injury, we find the brain regaining its influence rapidly, while the nervous influences of the cord are very slowly re-established, we have reasonable grounds to infer that the cord has suffered independently of the brain. Sir Charles Bell relates a case of a lady, who, being thrown in her carriage over a cliff, suffered concussion of the spine, with immediate and total paralysis of the extremities. She suffered, however, severely from pains in the limbs. Motion and sensation returned very slowly, and the accurate perception of the temperature of bodies still more gradually. Upwards of twelve months elapsed before this patient was entirely restored.

The treatment of concussion \* is indicated by the inflammatory reaction, which we must always be prepared to expect after such injuries. Thus we employ local bleeding, with cold applications, and saline purgatives, and afterwards use counter irritation. Compression of the cord may follow concussion, either by the rupture of its own blood-vessels, or by effusion consequent upon inflammation. Its effects are very analogous to those of compression of the brain, but we have not the same means of relieving the cord by operation, and must content ourselves with the most rigid antiphlogistic treatment, and trust to gradual absorption for removing the paralysis consequent upon pressure.

In nearly all cases of paralysis after injuries of the spine, we may observe the involuntary action of the spinal nerves when irritated at their extremities. Through the kindness of my friend, Dr. Budd of King's College, London, I am enabled to give two cases, † in which this action was very fully developed. Fractures of the spine constitute a class of accidents of considerable frequency, and present varieties of great interest, both as to nature and result. In considering practically these injuries, it is necessary always carefully to bear in

\* For cases of Concussion, see Appendix.

† For cases of Involuntary Nervous Action, see Appendix.



mind the condition of the cord, which gives them their great importance.

Fracture may occur in the bodies of the vertebræ, in their arches, or extending through both parts ; the portions of bone may be more or less displaced ; and the case may be complicated by fragments being driven in upon the cord, or by comminution of the bone, or extensive injury of the soft parts. Simple fracture of the arch is most likely to occur from the application of violence to a small space of the back, as by the pole of a carriage, by the fragments thrown off in blasting stones, or by spent balls. In cases of these kinds, the brittle texture of the arches gives way, before the force applied is conveyed to the more elastic and spongy bodies. In very old men, however, where all the bones have acquired an unusual degree of solidity, or even become partially ankylosed, such cases as would entail simple fracture of the arch in a young subject, will sometimes be found to have split both arch and body. Fracture of the bodies alone is most likely to arise from a general application of violence to the spinal column, twisting and crushing the vertebræ together. Perhaps the most usual causes of such fractures are falls of earth and rubbish in quarries or mines ; and the foot slipping while descending steps under heavy loads carried on the shoulder.

Such accidents also frequently cause fracture of both body and arch, but cases are not wanting in which local violence has produced fracture of the bodies\* without injuring the arches. The consequences of fracture are greatly modified by the region in which it has occurred. The dangers to be immediately apprehended are, after concussion, compression by considerable portions of bone driven in upon the canal, or irritation of the cord by smaller pointed fragments ; and more distantly the effects of inflammatory action set up in the cord, which may occur in cases where at first there appeared neither concussion nor mechanical irritation or diminution of the canal.

Fracture from general violence † is found in a large proportion of cases to exist in the cervical or lumbar regions. In the former case, it is very likely to cause immediate death, by the cord being bruised or lacerated at its upper part. In some instances, the portions of bone have been scarcely separated, yet the patient has died of suffocation within a short period, owing to the inflammation of the roots of the respiratory nerves. Fracture of the cervical vertebræ is, therefore, in all cases, imminently dangerous. Fracture in the dorsal

\* See Appendix, Millard's case.

† For cases of Fracture, see Appendix.

and lumbar regions is by no means so hopeless; and the less so, as the injury is further removed from the cervical region. Still a large proportion of cases terminate fatally, either by continuous inflammation of the cord spreading from the seat of injury, or more slowly, by the visceral derangement and exhaustion, consequent on paralysis of the lower extremities.

Comminution of the bones, of course, increases greatly the danger; from the additional chances of spiculæ wounding the cord, and the severity of consequent inflammation, which can hardly fail to arise in such cases.

Compound fracture of the spine must always be considered as a case of the most imminent peril; the danger, of course, being greater or less, according to the degree of injury to the soft parts, and exposure of the bones and cord. Gunshot fracture may, I believe, be looked upon as a desperate case, from the tedious process necessary to throw off and restore parts killed by the passage of the ball; and the impossibility of preventing a degree of inflammation that can hardly fail to attack the cord. The diagnosis of fracture is a subject of extreme difficulty, and frequently quite impossible. The treatment, however, fortunately varies little, from that to be pursued in other severe injuries, which may be confounded with frac-



ture. The extreme depth of the parts, the very slight displacement often existing; the fallacious appearances of projection and depression assumed by the processes; and, above all, the great risk of tedious and accurate manipulation, all tend to make the diagnosis of injuries of the spine extremely doubtful. The difficulties attending these injuries are best illustrated by the Reports of Cases, of which I have appended several, which appeared to be instructive in the points on which I have touched.

The prognosis of fracture must, like that of all injuries of the spine, be very guarded; knowing, as we do, how difficult it is to gain accurate views of the real state of each case; and how frequently those presenting the slightest immediate symptoms are eventually succeeded by the most fatal results. The circumstances which lead us to hope for a favourable termination are, the absence of paralysis, or, where it has existed, its rapid disappearance; the paralysis being confined to one set of nerves, as the motor or sensory nerves alone, showing rather a local than a general impression on the cord. The absence of depression, though of slight importance, is yet a negative ground for hope. On the other hand, we are necessarily alarmed by the paralysis being unyielding or increasing in degree; by torpidity of the viscera;

by gnawing pain in the paralysed extremities ; and by learning that the accident was of such a nature as would lead us to expect that both body and arch of the vertebræ have been crushed. The appearance of depression, on examining the spinous processes, is very fallacious, though, when it exists, it must of course tend to make us still more guarded in our prognosis.

The treatment of fracture must, like that of other severe injuries of the spine, be directed towards the prevention or diminution of inflammatory action. We must trust entirely to natural processes for the approximation and re-union of the fractured portions, as we have no means of keeping them in position, even should we be tempted to reduce them. When the parts involved in the injury, and the difficulties of accurate diagnosis are seriously considered, it will be readily admitted, that the manipulation requisite for any attempt at reduction, can, in hardly any case, be useful, while, in the very large majority of instances, it may be productive of the most fatal effects. If the spine is crushed, and the cord paralysed by depressed portions of bone, we cannot hope mechanically to raise or remove these portions. If, without paralysis, we still have suspicions of fracture, we have even less excuse for tedious manipulation ; for every motion of the

vertebræ is at the imminent risk of displacing fragments of bone, and producing instant pressure upon the cord. It was at one time maintained, and that by an authority justly celebrated in the profession,\* that we might cut down upon the spine, and employ the trephine and elevator to remove pressure. This practice was advocated upon reasons drawn from the analogy of the brain, when compressed, or irritated by fragments of bone, after fracture of the skull ; but this analogy really holds in one point only, viz. the injury inflicted upon a nervous mass by the intrusion of a depressed portion of bone. We must not be led away by the plausible argument, that because removal of compression relieves the brain, it will also relieve the cord ; for though, to a certain extent, this is the case, yet the cases, both favourable and unsuccessful, which we meet with in practice, furnish the clearest evidence of the fallacy of this reasoning as the guide to our practice. The arguments of Sir A. Cooper have been ably met and controverted, in the lectures of Sir Charles Bell on the Spine and Thigh-bone, in which he shows the danger and impropriety of operating in these cases.

We must always be uncertain as to the extent,

\* Sir Astley Cooper.

the direction, and often the very nature of the injury ; in this acknowledged uncertainty, we are not justified in converting, by our operations, a simple fracture into a compound one. We are in the present day astonished at the practice of the older surgeons, who, in all possible cases of fracture, fissure, or depression of the skull, used to cut down and trepan, simply because such was their rule ; and we now know, that a large proportion of the cases which they would have lost through their rude operations, recover without the interference of the surgeon. Knowing, then, as we do by ample experience, that the cord may suffer the most serious injury, unaccompanied by mechanical læsion ; and that paralysis may exist quite independent of pressure, even where fracture exists ; we are not warranted in taking it for granted, that a portion of bone is depressed, and must be raised, and in proceeding to do so by a most hazardous operation. Supposing, however, that the symptoms do really depend on depression of bone, and that we have been induced to operate, we very probably shall find the arch sound, or, if fractured, its fragments so little displaced, as to cause no compression which we can relieve. Thus we have cut down upon the cord, only to find that the portion of bone comes from the body of the vertebra, where we can by no means reach

it, and we are obliged to leave our patient unrelieved, and in a condition infinitely worse, as to his ultimate chance of recovery, than when we found him. It is possible that a case might occur, where the injury is precisely such as we may hope to relieve by operation, such as simple depression of a small portion of the arch alone. This, however, we never can be sure of, until our incisions are made, and the slender chance of meeting with such a case, can never compensate for the fearful probability, that we shall find not only that we have done no good, but that we have destroyed the only chance of recovery which our patient possessed. The only case in which the surgeon's interference is justifiable, is the very rare one of fracture, complicated with a large external wound, from which loose fragments of bone may be picked without violence. Even in such a case, nothing should be done, unless paralysis, appearing to depend on depression, was present.

The greatest caution must be employed in lifting or moving a patient with suspected fracture of the spine. Perhaps the best method is to slide a shutter or a hurdle under him, so as to avoid bending the back. The bed in which he is to be laid should be made extremely level, and pretty firm, so that his position may be altered as seldom as possible. Much caution must be observed both

in examining the spine, and in the use of means to relieve the patient at the periods of evacuation. Sloughing from pressure is very apt to take place, especially when paralysis prevents the patient from feeling the soreness which gives warning of its approach. The catheter is often required, and the condition of the urine should be carefully watched. The bowels are frequently torpid, and the digestion impaired, both of which call for strict attention. The patient must be carefully guarded against cold, motion, and all causes likely to excite inflammation.

When a case terminates favourably, it is usually by ankylosis, sometimes of the fractured portions, sometimes of two or more vertebra entirely, and the utmost caution is to be observed, long after the patient fancies himself quite strong, as any sudden shock, or an accession of cold, may rouse the dormant inflammation, and prove fatal at a period very far removed from the accident.

The duty of the surgeon is rather to prevent than to perform ; and, in every case in which he has the misfortune to lose his patient, he will find some additional reason to rejoice that he has avoided active operations. His principle, in all severe cases of spinal injury, should be, like that of Fabius, *cunctando restituere rem* ; and his chief attention should be directed to maintaining the



patient's constitution under the tedious confinement which his safety requires.

I cannot better conclude these observations, than in the words of my distinguished master, whose practical remarks on the subject are of the highest value :—" When called to a person who has received an injury of the spine, there must be much difficulty in ascertaining the degree and kind of injury. He may be paralysed with fracture ; he may have suffered fracture without paralysis ; he may be paralysed independently of fracture ; concussion may cause the symptoms ; extravasation may cause the symptoms. With strong suspicions of fracture, you are not to turn the patient, and press and press, and examine to satisfy your mind, when there is no plan of treatment to be directed by the result of that examination. You are in no case authorized to cut down upon the bone and trepan it, or to expose the spinal marrow or its sheath. I have earnestly assigned the reasons against it, and in opposition to crude mechanical notions. Our whole attention must be directed to preserve the spine at rest, and ward off the rising inflammation : do this, and follow as bold practice as you choose."\*

\* Op. Cic.





## A P P E N D I X.

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CASE I.—Sprain of the cervical vertebræ from local violence.  
—Paralysis limited to the arms.—Recovery.

Mr. B., while hunting, and stooping forward to avoid a branch under which he had to pass, received a blow on the left side of the face from his horse's head. The blow was not violent, nor did it stun him at the time, but he felt the neck twisted by it, and the arms were both instantly paralysed; the paralysis was more complete in the left than the right arm. The reins fell from his hands, and he was unable to raise his body, and shortly fell from his horse on the animal taking a leap. No injury appears to have been sustained at the moment of falling. Mr. B. rose unassisted, and was taken home in a carriage, after having a cordial of sp. lavand. comp. He was put to bed, and in the afternoon bled to 4 oz. only, which produced a marked effect, as he was by habit very intolerant of blood-letting. Mild aperients, and occasional antispasmodic draughts, were given, with pudding diet. Violent pains were from time to time experienced in the back of the head, but soon relieved by the application of cold to the parts. For a month recovery was extremely gradual, but after that time he moved about, and recovered more rapidly,

under the use of very light food, quiet, and abstinence from exertion.

The four fingers of the left, and the little and ring finger of the right hand, remained crippled for some time ; the corresponding fingers of the left hand were much the longest of regaining any power, and their last phalanges remain permanently contracted. Even now, at a distance of upwards of twelve years, Mr. B. occasionally experiences a jarring sensation among the vertebræ on any sudden rotation of the head, or in turning over during sleep. On these occasions, a twinge extends down to the fingers of the left hand, and a grating sensation is perceived for some hours afterwards among the vertebræ. The head was at no time displaced, nor was there any paralysis below the arms.

We have, in this case, an illustration of sprain from local violence, inducing paralysis of the nerves passing from the affected vertebræ. Such a case, if only a little slighter in degree, might have been readily passed over as a trifling accident ; and the patient, taking no pains to guard against the consequent inflammation, and living and taking active exercise as usual, would have rendered himself liable to the effects which will be detailed in the next case, as tending to a fatal termination of an apparently slight accident.

CASE II.—Sprain of the spine, by general twisting, from muscular action.—Gradual paralysis.—Death after an interval of twelve months.

A tall, powerful gentleman, of middle age, and who had in youth been remarkable for agility and strength, while on his passage from London to Edinburgh, caught a slight cold, and complained of pain in the loins, which was attributed to rheumatism. A few days afterwards, while playing with one of his children, and stooping to lift it from the ground, he felt a sharp pain dart across his shoulders, and from this moment he began to be sen-

sible of a gradually increasing paralysis of the extremities. This increased, until sensation and motion were both suspended ; but there was a continued gnawing pain complained of, and a febrile excitement, like that of rheumatism, continued present.

The action of the bladder stopped rather suddenly, only two days elapsing between its first being affected and its absolute torpidity. The abdomen became flaccid, the action of the diaphragm and abdominal muscles was suspended, and the patient breathed entirely by the chest, and could raise the shoulders in respiratory efforts, after the arms were entirely paralysed. The action and expression of the face remained after the whole body was paralysed, and the patient sank ultimately from exhaustion. On examination of the body, the arches of the vertebræ being removed, a bluish spot appeared upon the cord opposite to the second and third dorsal vertebræ, which were carious. There was also a deposition of pus and caries of the vertebræ at the junction of the lumbar and dorsal regions. On slitting up the sheath of the cord, it was found to be highly stained with blood, and evidently inflamed near the carious parts, and the whole cord was of the consistence of thick cream.

On very minute inquiry, it was ascertained, that, twelve months before, he had strained his back in throwing himself from a rearing horse. He had not, however, suffered much at the time, nor had he taken much care of himself in consequence. We can readily perceive how the back might be twisted in such a case by the sudden and violent action of a powerful man ; and the result shows us the injuries taking place just where our anatomical knowledge would lead us to expect them—viz. at the junction of the more flexible with the more fixed portion of the column. The painful feelings experienced at the two periods subsequent to the original injury, were probably owing to the low inflammation being aggravated by cold in the one instance, and exertion in the other. For this case I am indebted to Sir Charles Bell.

CASE III.—Paralysis of the lower extremities slowly following sprain of the loins.—Abscess and caries of the spine.—Death after three years.

Edward George, a heavy-looking florid lad of seventeen, admitted to the Middlesex Hospital, 10th March 1841. He states, that, as a boy, he has had excellent health ; but, being employed as a bricklayer's assistant, he has been used to carry heavy weights. About three years ago, while carrying a load on his shoulders, his feet slipped different ways, and he strained his loins violently. He was laid up for about a fortnight, during which he was in bed, and then gradually became able to move about. He continued to have occasional pains in the loins during two years, and especially when raising himself from stooping. After hard work, he found severe pain in the back and round the stomach. He continued working till August last, when he was obliged to give it up, but could still shuffle about, and was not confined to bed. In about four months more, he had lost all support from his legs, and has since been confined to bed.

He lies with the legs entirely deprived of motion. The sensibility remains unimpaired. Irritation of the soles of the feet produces very little involuntary action of the limbs. The pulsation in the femoral arteries is very feeble, that of the posterior tibials quite imperceptible. The heart's action is violent, and he says that some time before he was laid up, he had palpitation after any exertion. The only uneasy feeling that he now has is a kind of crackling in the loins. The urine passes pretty freely after a slight effort, and the fæces are retained unless very fluid. Two issues were used some time ago, but were only kept open for a fortnight, and seemed to do no good. This case was treated by strict rest, by issues in the back, and the internal use of Cantharides ; and for a while he seemed to gain some power over the limbs. After nearly two months, however, he became affected

with very severe headaches, the bladder and bowels lost their action, and he became delirious. The left side became entirely paralysed, and he died on the 15th May.

On examination, the brain was found to be unusually soft, especially the anterior lobes, and great commissure. The arachnoid was opaque at the base of the brain, and the ventricles contained some clear serum. Some blood was extravasated on the cord posteriorly, about the junction of the cervical and dorsal regions. On removing the arches of the upper dorsal vertebra, some pus was observed coming apparently from the thorax. The arachnoid of the cord was much distended with turbid serum. On opening the thorax, the lungs were found universally adherent by old depositions of symph, but their internal structure was healthy. The left ventricle of the heart was much attenuated. On removing the thoracic viscera, an abscess was observed on the anterior surface of the spine, extending from the first to the eighth or ninth dorsal vertebra, whose carious bodies and partially absorbed cartilages, formed its posterior wall. This abscess was very narrow, and tapered at each end. It contained some scrofulous-looking pus, which flowed into the canal of the cord by an opening through the body of one of the vertebra. Both the bodies and the arches of the vertebræ were carious and softened.

This case appears to illustrate the effects of a sprain by sudden muscular exertion under a heavy load. The chief injury probably occurred at the shoulders, though the pain was more immediately referred to the loins; and the lad being obliged to continue at work, there was continual exacerbation of the inflammation, which also probably developed the scrofulous tendency shown by the formation of abscess on the anterior part of the spine. The symptoms, though extremely slow in their course, never intermitted from the moment of the accident, and the slight remissions which treatment obtained were not of sufficient importance to offer any check to the fatal progress of the disease.



CASE IV.—Concussion of the Cord.—Return of power.

A man carrying on his head a heavy bag of hops, missed his footing, and fell down stairs. On being brought to the Middlesex Hospital, he was found to have the extremities completely paralysed, but without any loss of intelligence; in four days the use of the extremities was regained, and he soon after left the house. He died, however, of Pneumonia in a few weeks after going out; and on examination, a small fracture of one of the cervical vertebra was discovered.

This case, which I have been unable to get more particularly, yet furnishes evidence of the cord suffering from concussion, independent of the brain. There was no loss of sense, and the patient was perfectly able to express his ideas. The short duration of the paralysis prevents our attributing it to the fracture, whose effects would have been more durable, and, unless depending on depression, which did not exist, less instantaneous.

CASE V.—Incomplete Paralysis apparently depending on Concussion of the Cord, followed by compression.

A woman, about sixty years of age, was admitted to the Middlesex Hospital, the 18th of March 1841, having lost the power of motion in both her arms and in the right leg, consequent upon a fall down a flight of steps. In describing the accident, her own words are, that “she fell all in a heap;” and she persists in saying that she was hurt all over the body, and in no one place more than another. On careful examination of the spine, no point of peculiar tenderness could be found, nor was there any bruise on any part of the body. She complained most of pain between her shoulders, but there was no appearance of injury there. There is complete loss of motion in the right leg and in both arms, but sensation remains in these parts in a slight degree, so that she is sensible when they are pinched, though she complains of their

being numb. The abdominal muscles and diaphragm preserve their action during moderate respiration, but she is unable to make a violent effort, as in coughing. The bladder was distended when she was admitted.

*March 25.*—This patient, who is Irish, has a remarkable appearance; she utters loud complaints with all the emphasis of her country, and in tones by no means wanting in force, but, from the absence of all gesticulation, she looks as if confined in a straight jacket; turning her head from side to side, and moving the left leg a little, but the rest of the body absolutely motionless. She seems to suffer acutely, and constantly maintains that the pain is everywhere but in the head. The pain is worst at the shoulders and in the hands, but is also violent in the right thigh and leg, and in the abdomen; she expresses its nature as darting, burning, and piercing.

On tickling the sole of the right foot, which is the one paralysed, there is spasmodic contraction of the limb. She has been repeatedly asked whether she has pain in the course of the spine, and invariably says that it is all over her, but worst between the shoulders. When placed in a sitting posture, she makes no complaint of the spine; nor does moving her head from side to side, nor bending it forward, give her any uneasiness. These circumstances induce the belief that there is neither fracture nor displacement of the vertebræ, but that the paralysis results from extravasation of blood upon the cord. The partial nature of the paralysis may depend either on the blood being extravasated in greater quantity on the anterior than the posterior surface of the cord; or, it may be, that the posterior roots of the spinal nerves, being much deeper in their origin, are less liable to be injured by superficial pressure.

A blister was applied to the nape of the neck, and the bowels kept freely open. By the 28th, or ten days after admission, she had regained some command over the right leg, but the arms re-

mained powerless ; the left leg, which had never been much affected, is easily moved at will ; she continued to have a general tingling pain, and the urine passed from her involuntarily.

The next day her powers of motion were again diminished, the pain also was aggravated ; she had, however, rather more control over her water, and was sensible of its flowing ; the urine was offensive and turbid. Her breathing was somewhat impeded.

Her condition continued fluctuating, but, on the whole, she slowly improved, and especially in the power of using the legs—the right leg was so strong that she could walk along the ward with assistance, long before any material improvement took place in the arms. Before the leg regained this degree of power, it used to be drawn up spasmodically when pinched, and the same starting of the limb occurred when she sneezed or suddenly raised her voice. In walking, she required to be supported to avoid falling, as her foot, though tolerably strong, was not entirely under her guidance, and she flourished it about before being able to put it firmly down. This condition remained with little alteration to the middle of June, three months after her admission.

With regard to the arms, some little signs of returning power appeared about the end of March, and, till the middle of April, seemed progressive, but since then have been extremely slow. The order in which the muscles regained their tone was remarkably different in the two arms ; in the left, the muscles of the fore-arm were the first to recover ; while, in the right, the flexors and extensors of the elbow-joint showed the first signs of returning energy. At the last date of observation, she could grasp objects pretty firmly with the left hand, though she could not bend the left arm ; while she could move the right elbow, but was unable to use the fingers of that hand.

She has had intermissions of pain for a few days at a time, but it has always returned, and though referred to various parts of the body, is always most severe between and in the shoulders.



She has at different times been blistered and galvanized ; she has had baths, and a variety of remedies, in the hope of alleviating the pain ; but though fairly persevered in, none of the modes of treatment seem to have done much good, and her improvement has latterly been so slow as to be almost inappreciable.

I am indebted to Mr. Shaw, of the Middlesex Hospital, for the particulars of the above case, which I saw under his care at different periods.

**CASE VI.**—Paralysis consequent upon injury.—Illustration on the involuntary action of motor nerves supplying parts deprived of common nervous influence.—Gradual recovery, and proportionate cessation of involuntary action.

A young man was admitted into the Dreadnought Naval Hospital in September 1838, having fallen down the hatchway of a steamer, and struck the neck in falling. He remained perfectly conscious, but entirely paralysed, both as to motion and sensation, and continued so for about three months. The last cervical vertebra appeared to be fractured.

Although entirely deprived of voluntary motion, the limbs developed in an extraordinary degree the involuntary action of the nervous circle ; the feet were in the habit of starting, and when irritation of any kind, and particularly heat, was applied to the soles, the action of the legs was so violent as nearly to throw the patient out of bed. The urine and fæces passed from him involuntarily, and without his being conscious of their passage, for a long time after the accident.

By means of active treatment, and attention to the bowels and bladder, this patient regained in a great measure the command of his limbs, and when I first saw him, just a year after the accident, he could walk very tolerably with crutches. He had regained the sensation of passing both urine and fæces, though he had still no control over them. He has been much troubled with

shooting pains in his arms, and tingling in the legs; but these painful feelings are abating, and common sensibility taking their place. In like manner, as the legs come more under the power of the will, the involuntary action becomes less forcible, and the feet merely twitch slightly when irritated by heat or friction.

The general strength seems to have improved rapidly during the warm weather in this case, and the patient himself believes that the cold kept him back.

I had at the same time an opportunity of examining a case presenting very similar phenomena, accompanying, however, paralysis from the effects of cold. In this case, also, the limbs started involuntarily, and still more so when the feet were irritated. The case was treated by counter irritation and the internal use of strychnine in  $\frac{1}{8}$  grain doses, thrice daily, with apparent good effects. Sensation returned before motion, and as voluntary action regained its balance, the involuntary motions of the limbs became less energetic, and less easily excited by external stimuli.

#### CASE VII.—Fracture of the Atlas without injury to the Cord.—

Anchylosis of the Vertebrae, and death from affection of the Chest.\*

A stout man, of thirty-four, fell from a haystack sixteen feet high, pitching on his head. He was at first stunned, but soon recovered his senses; and though he had severe headache, there was no paralysis. After a short precautionary course of treatment he was able to leave his bed. In about a month an apparent enlargement was found about the upper cervical vertebra, and he was unable to move the head, and had very severe pain at the occiput, with some diminution of sensibility in the upper extremities. He complained of a lump in the throat, and found

\* This case, with a drawing, is given in the Medical Gazette, vol. v., p. 331.

difficulty in swallowing. The respiration likewise became impeded, and he died in about six months after the accident, with effusion in the chest. Leeches and counter irritation had been employed without advantage. On dissection, the atlas was found to be split transversely, and the transverse ligament ruptured; the anterior portion of the atlas was driven forward against the pharynx, while the posterior remained in its proper position, both in regard to the occiput and dentata. The spinal canal was thus not diminished in calibre, though slightly shortened by the head sinking forward a little. The cord escaped in this case from mechanical injury, and the patient lived long enough to have ankylosis of the fractured portions, the anterior of which was found firmly united to the dentata, while the posterior remained attached to the occiput, and served to keep the head in its position. Death appears to have been gradually induced by the inflammation of the nerves of respiration.

CASE VIII.—Fracture of the Spine, terminating unfavourably after six months.—Illustration of some of the difficulties in the Diagnosis of such cases.

S. Millard, forty-four years of age, a stout healthy man, was admitted to the Middlesex Hospital, 27th January 1836, having fallen down a flight of steps, against one of which he struck his back; his head also was severely cut and bruised in the fall. He had lost the power of the lower extremities, and sensation in all the parts below a line drawn round the body from the anterior superior spinous processes of the ilia. There was apparently depression of the spinous process of the fourth lumbar vertebra, but no fracture could be satisfactorily made out, as the parts were much swollen, and much manipulation inadmissible. He had a large dose of calomel, followed by a purgative draught, and was cupped in the loins to 12 oz.; this was repeated, and leeches applied by twenties several times, during the first week of his being in the

house. The bowels were extremely torpid, and the urine, which had to be drawn off, was offensive, high-coloured, turbid, and slightly acid. He had restless nights and frightful dreams.

On the eighth day some sensation returned about the hips and hypogastrium, and he became conscious of the fulness of his bladder, though unable to empty it at will; the urine required to be drawn off thrice daily, and deposited a thick white sediment; it was found to have become alkaline, and he was ordered a few drops of muriatic acid in infusion of cloves. He continued with little alteration in this state until within a few days of his death; having occasional rigors and pains in the line between the sensible and paralysed parts of the body. Once or twice he appeared to regain a slight degree of sensation in the legs and hips, but immediately to relapse. The bladder sometimes was under the control of the will, and sometimes the urine passed involuntarily, but he had for a long time before his death no sensation of its fulness, and only passed his urine because he knew it was time to do so. The bladder was frequently injected with warm water, and the acid continued to neutralize the alkalinity of the urine. In spite of every precaution, the hips sloughed from pressure, but the sloughs came readily away, and there seemed to be sufficient action in the parts to form granulations. The patient was placed upon the water-bed, and had every support from porter, cinchona, &c., but finally sank after much suffering from burning pain in the paralysed limbs and repeated attacks of diarrhœa. It should have been stated, that at one time he complained of severe pain near the last dorsal vertebra, and that he had at the same time a very severe rigor; an issue on each side of the painful point gave some relief.

On examination, the spinal cord was found to be generally inflamed and softened below the ninth dorsal vertebra, the body of which was split up, with little or no displacement. The lumbar vertebræ were uninjured, so that the apparent depression noticed

at first proved to have been fallacious ; depending, indeed, chiefly on the tumefaction of the soft parts, and the consequent difficulty of accurate examination. The bowels were considerably inflamed, and the bladder strongly contracted.

In the above case we have several points worthy of remark. We see the difficulty of accurate diagnosis in the real position of the fracture being overlooked, and its being erroneously supposed to be lower down. We have evidence that the body of a vertebra may be fractured without its arch suffering any injury, and that, too, by a force which would lead us to expect fracture of the arch either alone or at the same time as the body. We have a proof that immediate paralysis may occur without mechanical pressure upon the cord ; that severe pain may be felt in parts deprived of common sensibility ; that the viscera sympathize with the affections of the cord ; and that the fatal termination may be postponed to a very distant period by the slow nature of the inflammation.

#### CASE. IX.—Probable Fracture of the Spine.—Inflammation.—Paralysis.—Recovery.

Henry Lenney, aged twenty-five, a stout healthy young man, was carrying a sack of flour down a very steep stair ; he slipped, and the sack fell from off his shoulders, but he was not aware of striking himself ; he felt, however, at the moment, something crack in his back, of which he took little notice at the moment, as, though very painful, it did not prevent motion. He continued to move about till eight days after the accident, when he was exposed during a whole day to cold and wet, and felt a weakness in his loins ; this weakness increased rapidly, and in the course of two or three days, he had lost the use of his legs and the power of making water. In this state he was brought to the hospital. On examination of the spine, a very evident displacement of the tenth or eleventh dorsal spinous process was felt on passing the finger



gently down the ridge of the back; there was apparently little or no swelling of the soft parts to lead to error.

He was cupped to 12 oz. near the seat of injury; an active purgative was administered, and he had one-quarter grain of tartar emetic every six hours. On the third and sixth days after admission he was again cupped, and had twenty-four leeches applied, and the bowels were kept freely open. His urine dribbled from him when the bladder became filled, but he could not pass it at will, and the catheter was employed. Sensation was never entirely suspended in the legs, and in about fourteen days had returned to a considerable extent, with a proportionate improvement in motion. He slept well, and was free from pain, and had a good appetite. In a few days longer he could distinctly perceive the flow of his urine, though he could not command it at will. Four small issues were made round the injured point, and appeared to be useful, as he could very soon increase or diminish the stream of urine, his chief difficulty now being to commence its discharge. He continued steadily to improve for three months, under rest and counter irritation; and by the end of that period he was so far recovered, as to be able to creep about the ward with two sticks. Unhappily he one day caught cold, and had immediately violent pain in the loins, with shivering; the urine and faeces were both passed involuntarily, and the legs again became paralysed. By confinement and very active local depletion he again soon improved, and in three months from the second attack he left the hospital, walking well, and without uneasiness. He was cautioned to be careful of using any violent exertion, for fear of a relapse. As nothing more was heard of this patient, the probability is that his recovery was complete, and the case presents us with a fair illustration of a severe injury of the spine terminating favourably under treatment. Although I have given this case in illustration of fracture, I am aware that it may be objected, and with reason, that the fact of there being fracture

was never fully made out ; this must be admitted, and possibly the case may have been one of sprain. At all events, we have an example of the manner in which general violence may affect the spine, usually causing injury at or near the union of the more fixed with the more moveable portions ; the benefit resulting from active depletion in the early stage, and counter irritation at a more advanced period. The very slow progress of such cases is also marked ; and likewise the liability to relapse, on any new cause stirring up the inflammation which we have been labouring to suppress.

From frequent and careful examination of the case, my own opinion was, that it was one of simple fracture of the arch, with some displacement as to the relative position of the spinous processes, but without depression or any mechanical interference with the cord, which remained unaffected during several days. The subsequent train of symptoms was such as might be readily accounted for either by simple fracture or by sprain, the inflammation in either case running the same course, and leading to the same results.









